AIRSUB-PORT: Inspection of habours with a ROV

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1. Introduction

AIRSUB-PORT is a project of investigation financed by the Spanish ministry of science and of the technology within the coordinated AIRSUB together with the universities of Girona and of the Balearic Islands, with the aid of industrial agents, it will be centred in three specific dominions: a) Inspection of ports, b) Inspection of dam, and c) Inspection of cables, to explore the industrial applications of underwater robots.

The Polytechnic University of Catalonia takes care of tasks of the inspection of ports with a ROV. At the moment there are several companies that offer inspection of ship's hulls and wharves, but that inspection is based on the images of video and photography that catches the ROVs and that later will be viewer by the maintenance technicians. The VideoRay company has a ROV with umbilical cord to make the inspection of ship's hulls and wharves. Also several commercial companies exist that have ROV for the accomplishment of inspection of wharves, among them BM to underwater (Greece), Underwater Inc. Rezurces (the USA), Nova Inc. RAy (the USA), Sub-atlantic LTD (Great Britain), Marine Technology Society (the USA) jointly with the University of Florida. In 2001 it made an inspection of the wharves of dock and leaned of the port of Barcelona, using camcorders operated by divers, it is inspection served to plan maintenance works to make in this port.
The objectives of this project are the inspection of ports with a ROV (fig 1), using technologies outposts of processing of submarine images with diffuse techniques, to determine the degradation and detection of faults in the wharves
In order to reach these objectives two systems will be made:

- A system of acquisition of images, to geo-reference them and after the mission, the assembly of collected images will be used for setup a mosaic of the image of the walls and foundations of the wharves of the port. We glided to use the system mosaicking of the image of Galadriel that has been developed in the laboratory of the University of Girona.
- A system of processing of submarine images with diffuse techniques, to determine the degradation and detection of faults of the wharves.

2. Inspection of the walls and foundations of the wharves of the port

The investigating equipment in submarine robotics of the UPC [2] has made tests of inspection of the pillars of docks of the port of Mataro. In this work of field the Barcelona boat of the Faculty of Nautical has been used like support ship of Barcelona where all the system of guidance and recording of video mounted and from where teleopereded the ROV [1] for the acquisition of images of the pillars. In the accomplishment of these tests had the necessity to position in 3D the ROV and to have a real cartography digitized 3D of the harbour.
Meetings with the president and heads of the area of conservation and maintenance of the Port of Barcelona have been made to analyze the necessities of inspection of the port where the use of the submarine robotics can contribute of remarkable way.

The main problem of inspection which at the moment are the services of conservation and maintenance of the ports is the degradation that takes place in the walls and foundations of the wharves, due to the erosion of the water when hitting against the wharf, impelled by the cross-sectional helices and nozzles of the ships when making its manoeuvre of dockage and moorage. This significant deterioration of the wharf (fig 2) implies that it is necessary to make periodic inspection of these elements.
For it they will be had to take periodically images from all the wall and foundations of the wharf, locating them in 3D [3], on the digital cartography 3D created to this end of the postulant of the Port of Barcelona, to be able to determine the anomalies and faults of the walls and foundations of the wharves. At the moment, the Port of Barcelona uses equipped professional divers with submarine cameras for the inspection of its facilities. The Faculty of Nautical of Barcelona (Department of Engineering of Systems, Automatic and Computer science Industrialist) counts on harbour facilities in the Port of Barcelona, that consist of cranes, hangar, wharves and lamina of water, we have collaboration with the Laboratory of Marine Engineering of the UPC to make tests in the channel of 100 meters of length and for the accomplishment of the tests of evaluation of the march of the project the EPO Harbour Authority of Barcelona yields their facilities to us, also we counted on a boat of 12 meters that we used like support ship in the accomplishment of the tests and a tow-caravan for the transfer of the robot.

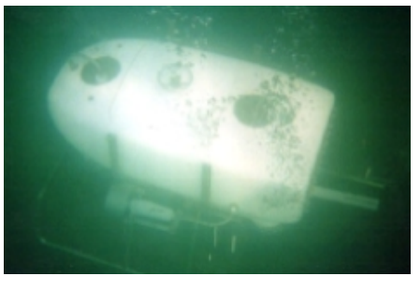

Figure 1. Underwater ROV Sailing o.

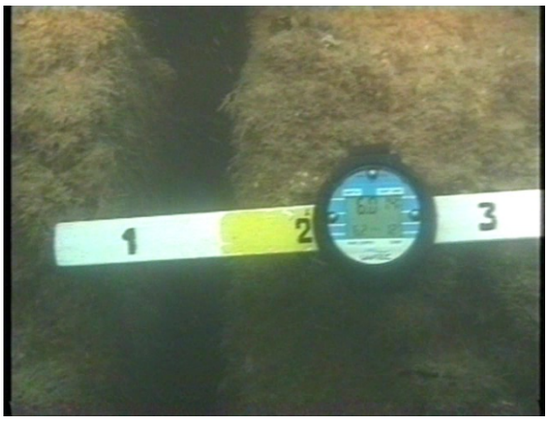

Figure 2. Crack in the wall of a wharf.

3. Conclusions

The use of a teleopereded vehicle, equipped with umbilical cable, avoids the problem to have own energy and to have a data line and images of high capacity, but it entails some difficulties of access and manoeuvrability, due to the presence of the umbilical cable.

Parallel dead-reckoning navigation to the wharf to different depths will be made to catch the images of the walls and foundations of the wharf, being processed itself the images to determine if anomalies or faults exist and later if degradation of the wharf takes place, locating each image in the digital cartography of the postulant. The use of diffuse techniques [4] for the analysis of the submarine images of the walls and foundations of the wharves of the port, will allow carrying out a more effective maintenance automatic/half-automatically.

4. References

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AIRSUB: Autonomous Robot For Dam Inspection

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1. Introduction

AIRSUB is a research project funded by the Spanish Ministry of Science and Technology with aim to explore the industrial applications of underwater robots. To achieve this goal AIRSUB, with the help of industrial agents, will study different application scenarios for this technology. Then, the project will focus on three specific domains: (1) dam inspection, (2) cable/pipe inspection and (3) harbour inspection. This is a join project where the University of Girona will focus on dam inspection, the University of the Balearic Islands will work on cable/pipe inspection, and the Politechnical University Of Catalonia will deal with harbour inspection tasks. The aim of this paper is to present the goals corresponding to the subproject of the University of Girona entitled “Autonomous Robot for Dam Inspection”.

2. Dam Inspection

Although there are several companies claiming to provide underwater robots for Dam inspection (Seabotix, VideoRay, FrugoSurvey, InuktunServices,...) often none of them is providing an integral solution to the dam inspection problem. Normally they propose the use of small class ROVs, working as teleoperated cameras for video recording, to replace the professional diver WHO traditionally occupied this place. There exist very few research precedents providing an added value solution. One of the most relevant works is the ROV3 system developed by the researchers of the Institut de recherche HydroQuébec (Canada) [1]. It is a small ROV, localized through a LBL system, which makes use of a multibeam sonar for collision avoidance. The system is able to control the distance to the wall and includes several video cameras as well as a laser system for 2D and 3D measurements.

The COMEX and the Electricité De France companies (France) developed a similar project [2]. In this case, a ROV manufactured by COMEX was localized using a 5 transponders LBL. Again, several video cameras together with 2D (double spot) laser system was used to take measurements. The Soniworks Company is selling a very accurate wired LBL navigation system to localize an ROV with centimetre accuracy. The system is combined with a GPS to geo-reference the imagery gathered with the ROV. Nevertheless, the system is not able to register the images to provide a big image mosaic of the surveyed area. Moreover, in all the previous systems the use of LBL makes the